

REMARKS

Claims 1-20 are all the claims pending in the application. Claims 5-18 have been withdrawn from consideration as the result of a restriction requirement.

Claim Rejections - 35 U.S.C. § 102

Claims 1-4 have been rejected under 35 U.S.C. 102(b) as being anticipated by Ryukichi et al. (JP Pub. No. 2000-036484 hereinafter as "Ryukichi"). Applicant traverses these rejections because Ryukichi fails to disclose or suggest all of the claim limitations. Specifically, Ryukichi fails to disclose or suggest at least the following:

Claim 1:

wherein said organic insulating film has an insulated modified portion in a side wall of said opening, and
said modified portion includes nitrogen atoms.

One aspect of the claimed invention includes the formation of a modified portion containing nitrogen in a side wall. For example purposes only, on page 22, lines 8-23, the used gas is oxidizing N_2 - O_2 gas in which nitrogen gas is the main gas and as described on page 22, line 8-23 the N_2 composition is more than or equal to 70% of the N_2 - O_2 gas. In the embodiment described on page 23, line 24, the nitrogen gas is 79%. It is noted that the side wall immediately after the etching is very active so that the material of the side wall acts with nitrogen as the main component gas to form the modified section.

In contrast, the object of Ryukichi is to form the opening by dry etching the organic film and it does not form a modified section containing nitrogen in the side wall of the opening.

Although Ryukichi describes that nitrogen is contained in the etching gas, in actuality, a deoxidization gas is used that is a mixture of the nitrogen gas and a hydrogen gas where the nitrogen gas is **not** the main component. However, the present invention discloses that in order to nitride the organic insulating film with an etching gas, it is necessary to use an oxidation gas that contains the nitrogen gas as a main component so that the **nitrogen carbide film is not decomposed**. Because, Ryukichi discloses using a deoxidization gas, where nitrogen is not the main gas and that the nitrogen carbide of carbon and nitrogen in the organic film is deoxidized and decomposed, it can not disclose the dry etching to the organic film having the modified section containing nitrogen in the side wall of the opening. Therefore, Ryukichi fails to disclose at least the claim 1 feature of the organic film **[having] an insulated modified portion in a side wall of said opening, and said modified portion includes nitrogen**.

Further, even if the fluoride of CH_2F_2 is added to the etching gas (as in paragraphs 0041-0042 of Ryukichi), because the etching gas having the nitrogen gas as the main component is **not** used, Ryukichi fails to disclose the claim 1 feature of the organic film **[having] an insulated modified portion in a side wall of said opening, and said modified portion includes nitrogen**.

In regards to claims 3 and 4, Applicant assumes that the Examiner is referring to Ryukichi and not Shinichi (Office Action page 3). However, if this is not the situation, Applicant respectfully requests that the Examiner provide a motivation to combine – or allow the claims.

Therefore, at least for the above reasons, Applicant respectfully submits that claim 1 is patentable over the applied references and respectfully requests the Examiner to withdraw the rejection.

Additionally, Applicant respectfully submits that rejected claims 2-4 are allowable, at least because of their dependency.

Claim Rejections - 35 U.S.C. § 102

Claim 1 has been rejected under 35 U.S.C. 102(b) as being anticipated by Shinichi (JP Pub. No. 2000-114367). Applicant traverses these rejections because Shinichi fails to disclose or suggest all of the claim limitations. Specifically, Shinichi fails to disclose or suggest at least the following:

Claim 1:

wherein said organic insulating film has an insulated modified portion in a side wall of said opening, and
said modified portion includes nitrogen atoms.

Shinichi fails to disclose the amended claim 1 feature of said organic insulating film [having] an insulated modified portion in a side of said opening, and said modified portion includes nitrogen atoms. In Shinichi, the object is improvement of fitness of Cu with an organic insulating film. Therefore, Shinichi does not always need a modified layer in the side wall of the opening (Figs. 1 and 2).

In contrast, in the present claimed invention, an object is protection from damage through diffusion of etching gas during a semiconductor process, especially, a dry etching. Therefore, it is

always necessary to form the modified portion in the side wall of the opening, and it is necessary that the modified portion is formed of insulated nitrogen carbide containing nitrogen atoms physically and mechanically firmly.

Consequently, Shinichi fails to disclose or suggest an organic insulating film [having] an insulated modified portion in a side wall of said opening.

Further, in Fig. 1 of Shinichi, a modified layer 14 is formed containing nitrogen on the surface of the organic insulating film 21 and in the bottom of the opening 22, by irradiating N_2 ions to the organic insulating film 21 having the opening 22. In this case of irradiation of N_2 ions, the modified layer containing nitrogen is formed in the side wall due to straight movement property of the ions. Therefore, the object of Shinichi is the improvement of fitness with Cu, and this object can be attained even if the modified layer is not formed in the side wall.

In Figs. 3 and 4 of Shinichi, the modified portions 34 and 45 containing metal are formed in the bottom of the opening and the side wall through solid diffusion from the Cu-Ti alloy layer 33. In this example, Ti (metal) is diffused to improve the fitness with Cu (metal). Because, the modified portions containing metals, protection cannot be attained from damage due to etching gas diffusion during dry etching, Shinichi can not disclose the claim 1 feature of an organic insulating film [having] an insulated modified portion in a side wall of said opening.

Therefore, at least for the above reasons, Applicant respectfully submits that claim 1 is patentable over the applied references and respectfully requests the Examiner to withdraw the rejection.

Claims Rejections - 35 U.S.C. § 103

Claims 2-4 and 19-20 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Shinichi (JP Pub. No. 2000-114367) as applied to claim 1 above, and further in view of Ellingboe et al. (U.S. Patent No. 6,114,250 hereinafter "Ellingboe"). Applicant traverses these rejections because Shinichi, either alone or in combination with Ellingboe, fails to disclose or suggest all of the claim limitations. Specifically, the references fails to disclose or suggest at least the following:

First, these claims should be allowable based on their dependence from claim 1 for the same reasons described above because Ellingboe fails to make up for the deficiencies of Shinichi.

Ellingboe does not disclose that an insulating modified section containing nitrogen is selectively formed only in the side wall of the opening of the organic insulating film. In Ellingboe the etching gas is the deoxidization gas of N_2-H_2 in which hydrogen gas and nitrogen gas are mixed. As explained above in Ryukichi, an oxidization gas which has a nitrogen gas as the main component and which does not decompose the nitrogen carbide film is required to nitride the organic insulating film with the etching gas. In case of deoxidization gas, the nitrogen carbide film of carbon and nitrogen in the organic film is deoxidized and decomposed. Therefore, even if the dry etching as explained in Ellingboe is performed, the modified 4 section of nitrogen carbide is not formed in the side wall of the opening.

In addition, with respect to claim 2, even if a little amount of fluoride gas is added in Ellingboe (Col. 1, Lines 57-67, Col. 2, lines 44-54), because the oxidizing etching gas containing

the nitrogen gas as a main component is not used, the modified section containing nitrogen is not formed in the side wall. Therefore Shinichi, either alone or in combination with Ellingboe fails to disclose the claim 2 feature of a modified portion further comprising fluorine and nitrogen.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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